PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-326555

(43)Date of publication of application : 25.11.1994

(51)Int.Cl. H03H 17/02
H04N 7/13

(21)Application number : 05-320021

(22)Date of filing : 20.12.1993

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(30)Priority

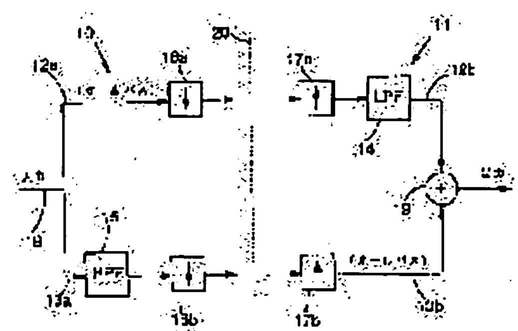
Priority number : 92 9226536 Priority date : 21.12.1992 Priority country : GB

(54) SUB-BAND FILTERING DEVICE AND APPLICATION THEREOF

(57)Abstract:

PURPOSE: To reduce hardwares in numerous sub-band encoding systems by providing only one half-band filter in respective low and high-band passing parts, placing the filters in an opposite stage and supplying the required symmetry.

CONSTITUTION: The all-pass path 12a and high frequency path 13a of a decimation stage 10 are respectively provided with decimeters 16a and 16b in them. Similarly, a low-frequency path 12b and an all-pass path 13b of an interpolation stage 11 are respectively provided with interpolators 17a and 17b in them. Then, both the paths 12a and 13a of the stage 10 are connected to common input 18 for receiving input signals, and both paths 12b and 13b of the stage 11 are connected to an adder 19 for adding signals outputted along both paths. Then, signal transmission and recording 20 are performed at a rate half the sample rate of the signals supplied to the input 18. Filters 14 and 15 are provided with odd-numbered taps, an LPF 14 and an HPF 15 are half-band filters, the HPF 15 is provided with the coefficient of the same size as the LPF 14, and the polarity of every two coefficient is alternately inverted.



LEGAL STATUS

[Date of request for examination]

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[Date of final disposal for application]

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[Date of registration]

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DESCRIPTION OF DRAWINGS

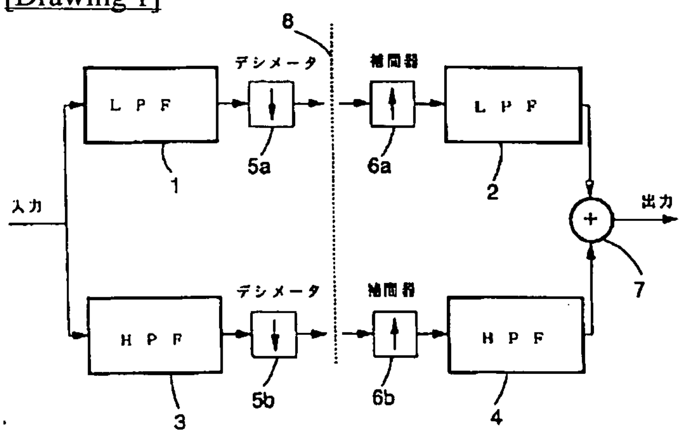
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the example of the easy filter equipment used for sub band coding.
[Drawing 2] It is the block diagram showing the example of the multistage filter equipment used for sub band coding.
[Drawing 3] It is the property Fig. showing the typical frequency response of the half band filter used for this invention.
[Drawing 4] It is the property Fig. showing the time response of the half band filter used for this invention.
[Drawing 5] It is the block diagram showing the 1st example of this invention subband filter equipment.
[Drawing 6] It is the block diagram showing the 2nd example of this invention subband filter equipment.

[Drawing 7] It is the explanatory view showing full reappearance actuation of the filter equipment of drawing 5 .
[Drawing 8] It is the explanatory view showing conversion of a jump format from the progressive scan of the video signal by the equipment of drawing 5 .
[Drawing 9] It is the explanatory view showing reduction of the frame rate of the progressive scan video signal by the equipment of drawing 5 .
[Drawing 10] It is the block diagram showing the application of the filter equipment of drawing 6 .
[Drawing 11] It is the explanatory view showing the mirror image escape technique for reducing the edge effect of this invention filter equipment.
[Drawing 12] It is the block diagram showing the example of the equipment which realizes mirror image escape technique of drawing 11 .
[Description of Notations]
10 Decimation Stage
11 Interpolation Stage
(12a, 12b) (22a, 22b) Low frequency way
(13a, 13b) (23a, 23b) RF way
16a, 16b DESHIMETA
18 Common Input
17a, 17b Interpolator
19 Synthetic Means
14 Low Pass Half Band Filter (LPF)
15 High Pass Half Band Filter (HPF)
46 Mirror Image Edge Escape Means
40 Random-Access-Memory Means (RAM)
42 Addressing Means
44 Digital Filter IC

[Translation done.]

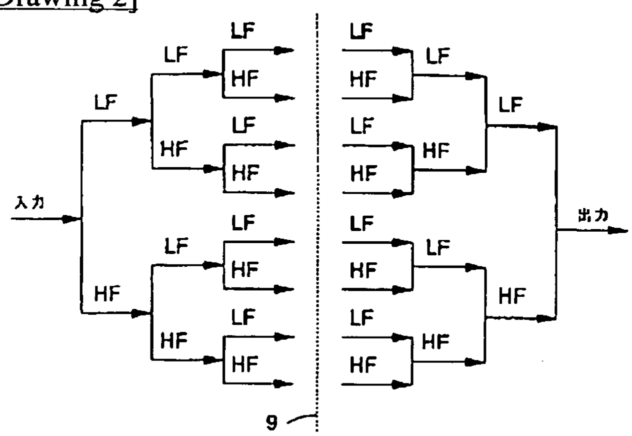
DRAWINGS

[Drawing 1]



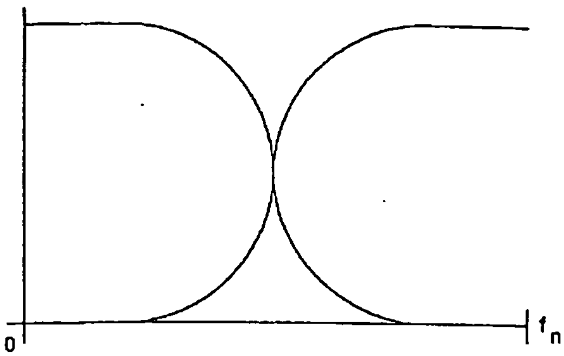
サブバンド符号化用フィルタ装置の簡単な例

[Drawing 2]



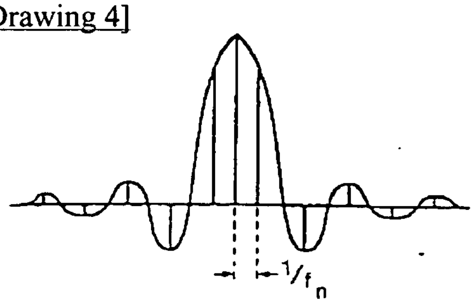
サブバンド符号化用フィルタ装置のもっと大きな例

[Drawing 3]



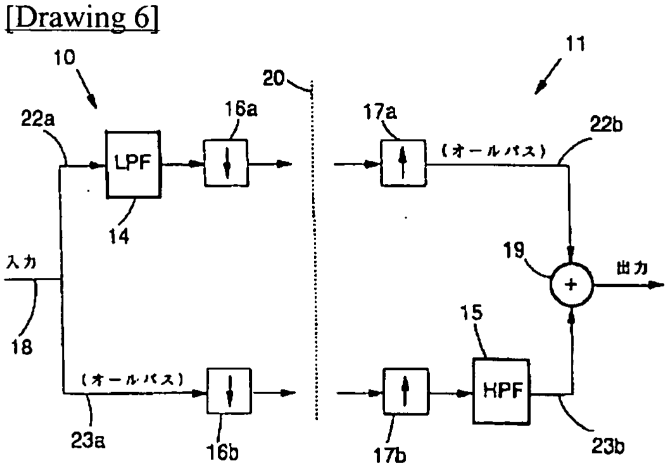
ハーフバンド・フィルタの周波数応答

[Drawing 4]



ハーフバンド・フィルタの時間応答

[Drawing 6]



本発明サブバンド・フィルタ装置の第2実施例

[Drawing 10]

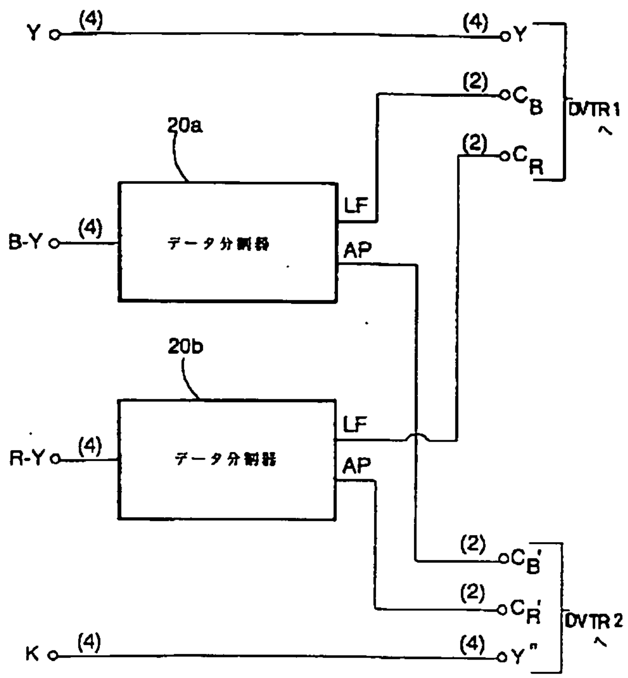
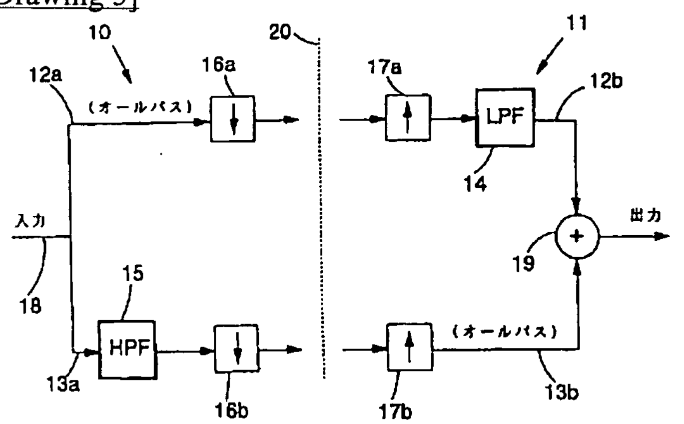


図6のフィルタ装置の応用例

[Drawing 5]



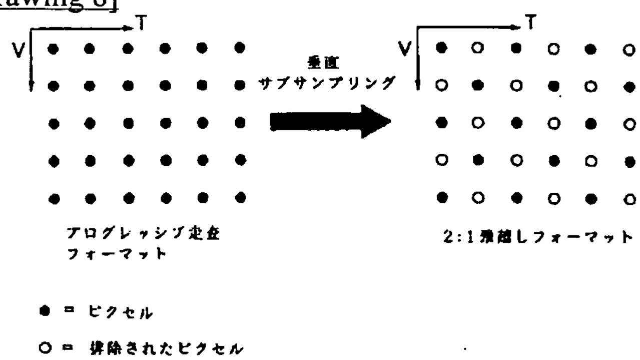
本発明サブバンド・フィルタ装置の第1実施例

[Drawing 7]

(a) 入力	0	0	0	0	0	1	1	0	0	0	0
(b) デシメータ16aの出力	0	.	0	.	0	.	1	.	0	.	. 0
(c) LPF14の出力	0	0	0	-1	0	9	16	9	0	-1	0
(d) HPF15の出力	0	0	1	1	-9	7	7	-9	1	1	0
(e) デシメータ16bの出力	.	0	.	1	.	7	.	-9	.	1	.
(f) 補間器17bの出力	0	0	0	1	0	7	0	-9	0	1	0
(g) 加算器19の出力	0	0	0	0	0	16	16	0	0	0	0

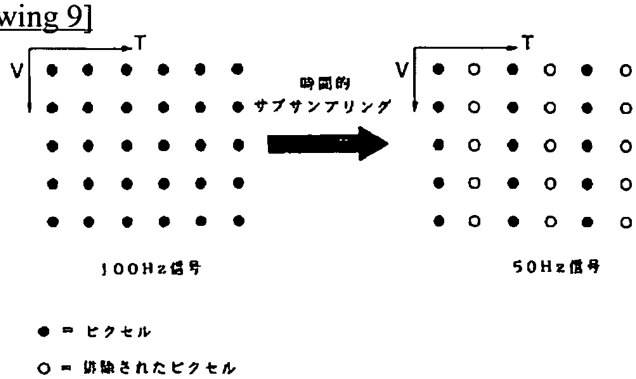
図5装置の完全再現動作

[Drawing 8]



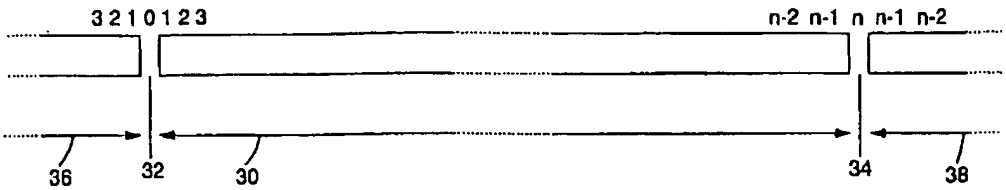
プログレッシブ走査から飛越しへのフォーマット変換

[Drawing 9]



プログレッシブ走査ビデオ信号のフレームレートの低減

[Drawing 11]



鏡像拡張技法

[Drawing 12]

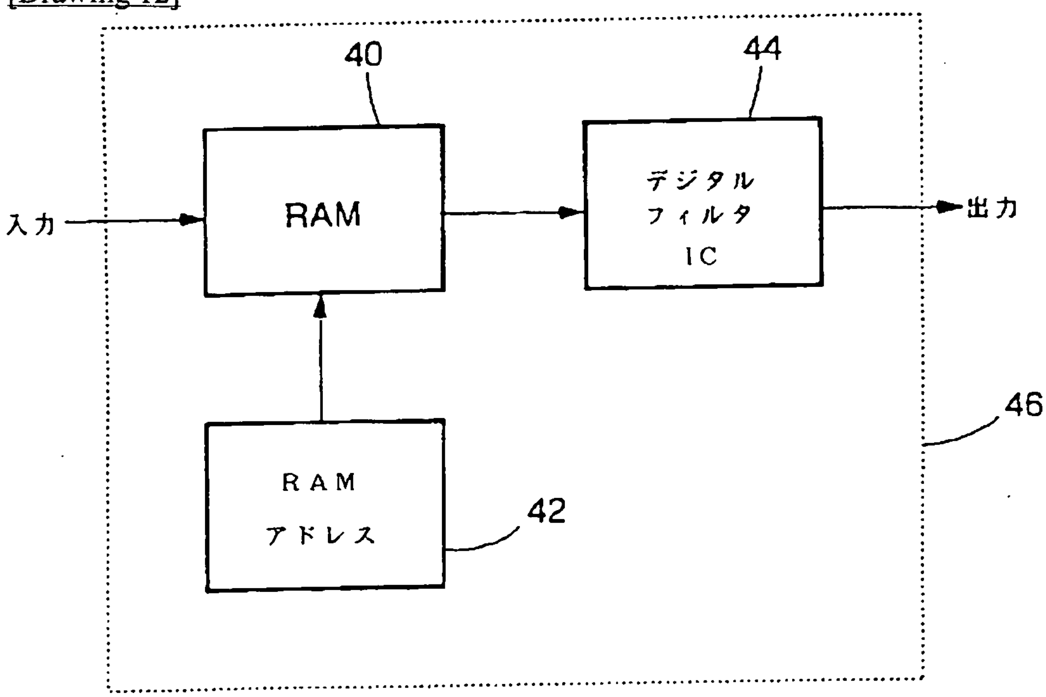
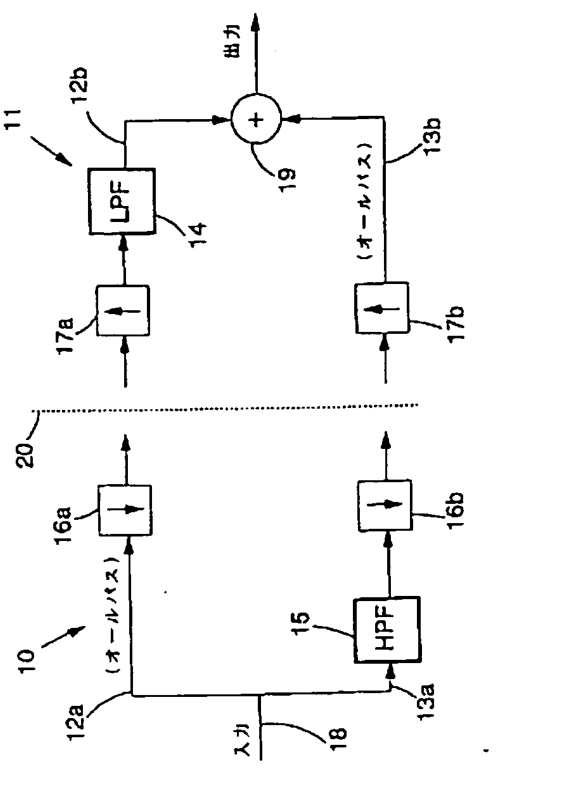


図１１の技法を実現する装置の例

[Translation done.]

Drawing selection Representative drawing



本発明サブバンド・フィルタ装置の第1実施例

[Translation done.]

OPERATION

[Means for Solving the Problem and its Function] This invention subband filter equipment has a decimation stage and a interpolation stage, it connects with the common input from which each stage of a decimation stage has one DESHIMETA, and each stage receives an input signal including a low frequency way (pass) and a high frequency way, and each way of a interpolation stage is connected to a means to compound the signal which has one interpolator and is outputted along both ways. This invention equipment prepares further the low-pass half band filter which has odd taps in the low-frequency way of one stage of decimation and a interpolation stage, prepares an all pass (passage all over the districts) filter in the low-frequency way of the stage of another side of the stage, prepares a complementary high-pass half band filter in the high-frequency way of the stage of another side of decimation and the number of interpolation, and prepares an all pass filter in the high-frequency way of the stage of another side of the stage.
[0009] Therefore, the filter equipment by this invention includes only the filter stage of the moiety of the equipment proposed before from an all pass filter being prepared in one side of the way of two decimation and a interpolation stage, respectively (that is, these ways being mere all pass ways). In what was proposed before, a half band filter is used for each of a high region and the low pass section as the 1st filter. Although full reappearance is attained by determining the multiplier to the tap of the 2nd filter in each part that a fold lump of two filters in each part will become a half band filter, and making symmetrical a high region and the low pass section In this invention, full reappearance is simply attained by preparing only one half band filter in each of low and the high pass section, putting these filters on an opposite stage, and conferring necessary symmetric property. Therefore, if the filter equipment by this invention is used for a sub-band-coding system, it can compare with above-mentioned conventional equipment, and hardware can be remarkably decreased in an a large number sub-band-coding system as shown especially in drawing 2 .
[0010] Like the after-mentioned, a half band filter needs to have the die length of an odd number tap, in order to attain full reappearance. Moreover, a means to compound the signal outputted along with interpolation **** is a rate equal to the multiplier value of the centre tap of a half band filter, and is good to constitute so that the level of a composite signal may be lowered so that the restored signal may have the same signal level as the HARASHIN number level.
[0011] The filter equipment by this invention can be advantageously used in some fields of video signal processing. When LPF is in the interpolation stage of filter equipment and HPF is in the decimation stage of filter equipment especially, this invention offers the video signal processing system equipped with the following filter equipments for processing the progressive (one by one) scan format video signal supplied to the input of the decimation stage of filter equipment. In the system, the delay element of a half band filter As those filters are constituted as a perpendicular filter, it is the Rhine delay element. DESHIMETA of a low frequency way It is constituted so that pixel (pixel) Rhine of the odd number in the continuous progressive scan frame supplied to this and even pixel Rhine may be chosen by turns. DESHIMETA of a high frequency way is constituted so that even-pixel Rhine and odd-pixel Rhine in the corresponding continuation frame supplied to this may be chosen by turns. Thereby, the

signal outputted along the low frequency way of a decimation stage at the time of use turns into a 2:1 jump format video signal which has a field rate equal to the frame rate of an input progressive scan format signal. Since wave filtration of the 2:1 jump format signal especially outputted along the low frequency way of a decimation stage is not carried out, this configuration is advantageous, therefore it does not have the loss (loss) of perpendicular direction resolution, and can reproduce a original progressive scan format signal further that top. On the other hand, the loss will arise in the vertical definition of a 2:1 jump format signal, since a filter is in the low frequency way of a decimation stage supposing it uses similarly the filter equipment proposed in front of the **** for progressive scan-jump conversion. Therefore, the image obtained by the display of the jump signal will become a "bearish" thing.

[0012] When LPF is in the same filter configuration, i.e., a interpolation stage, and HPF is in a decimation stage, this invention also offers the video signal processing system equipped with the following filter equipments for processing the progressive scan format video signal supplied to the input of the decimation stage of filter equipment. The delay element of a half band filter is a frame delay element, as those filters are constituted as a time amount filter, DESHIMETA of a low frequency way is constituted so that the frame in every other one of the above-mentioned progressive scan signal may be chosen, and DESHIMETA of a high frequency way consists of the system so that the frame corresponding to the frame chosen by DESHIMETA of a low frequency way may be eliminated. Thereby, the signal outputted along the low frequency way of a decimation stage at the time of use turns into a progressive scan format video signal with a frame rate equal to one half of the frame rates of an input signal. Therefore, reduction of the frame rate of a progressive scan signal can be attained, without carrying out wave filtration of the signal with which the frame rate outputted by DESHIMETA of a low frequency way decreased, while enabling perfect reappearance of the HARASHIN number. On the other hand, the low frequency decimation filter of these equipments will produce time ****** to the signal with which the frame rate decreased, supposing it uses similarly the filter equipment proposed in front of the ****.

[0013] In a video signal processing system which was mentioned above, it can transmit to a low frequency output, or the high frequency output [DESHIMETO / output] can be encoded in the all pass output [DESHIMETO / output / in order to transmit through a separate channel]. Therefore, this system may also include a means to encode the signal outputted along the high frequency way of a decimation stage in the signal outputted along the low frequency way of a decimation stage in order to transmit, and a means to decode to a component signal in order to supply the transmitted signal to corresponding interpolation ****.

[0014] The filter equipment which materialized this invention can include a mirror image (symmetry) edge escape means to which specular reflection of the sampled value is carried out in the edge (edge) of the sample array supplied to a half band filter, in order to reduce the edge distortion effectiveness. This symmetry edge escape means may also include the random-access-memory (RAM) means for memorizing the sample supplied to a half band filter, and the addressing means for carrying out the address to the above-mentioned RAM means alternatively according to the sample which should be supplied to the above-mentioned filter so that it may state later.

[0015] This invention changes a progressive scan format video signal into a 2:1 jump format signal, and is extended even to the approach of reproducing a original progressive scan format signal later using this 2:1 jump format signal. This approach is performed using the filter equipment described until now.

[0016] This invention is extended also to the approach of changing the 1st progressive scan format video signal into the 2nd progressive scan format video signal with a frame rate equal to one half of the frame rates of this 1st signal again, and reproducing the 1st signal of the above later using this 2nd signal. The approach is performed using the filter equipment described until now.

[0017] furthermore, this invention -- 4x4 video signal -- the 1st and 2nd 4:2:2 video signals -- changing -- after -- this -- it is extended even to the approach of restoring 4x4 video signal from the 1st and 2nd 4:2:2 video signals. The approach is performed using one pair of filter equipments which described each filter equipment until now. This application is described later.

[0018] Generally, when the description is described with reference to the equipment by this invention in this specification, the same description should be given by this invention approach, and please understand that the same is said of the reverse.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Although this invention relates to subband (band division) filter equipment and its application, and application especially in the field of video signal processing, it is not necessarily restricted to this.
[0002]
[Description of the Prior Art] The subband filter equipment used for sub band coding is well-known. Sub band coding is terminology applied to the coding technique which decomposes an input signal into some narrow bands (subband) using 1 set of filters. DESHIMETO (subsample) of the separated subband is separately carried out for the purpose, such as a communication link and record. In a restoration phase, wave filtration of the signal [DESHIMETO / signal] is interpolated and carried out, it is added, and the HARASHIN number is reproduced. generally sub band coding is applied to processing of voice and (or) a video picture signal.
[0003] Drawing 1 is the block diagram showing the easy filter equipment used for sub band coding. This equipment has a low pass filter (LPF) 1, LPF2, a high pass filter (HPF) 3, and HPF4. Filters 1 and 3 are connected to a common input, and the stream of the sample inputted is received. The output of filters 1 and 3 is connected to DESHIMETA 5a and 5b, respectively. Filters 2 and 4 receive an input from Interpolators 6a and 6b, respectively, and the output of these filters is compounded with an adder 7, and turns into an output of each filter. This equipment is taking record, transmission, etc. of the signal between DESHIMETA 5a and 5b and Interpolators 6a and 6b into consideration (8 shows.). Wave filtration of the signal supplied to the input is carried out with filters 1 and 3, and DESHIMETA 5a and 5b chooses or eliminates the sample supplied to this, respectively, and reduces a sample rate at the rate of 2. Therefore, record of the output signal of DESHIMETA 5a and 5b, transmission, etc. are performed by the sample rate of the one half of a original input signal (8). This sample rate is restored to the location of the sample thrown away by corresponding DESHIMETA 5a and 5b by the interpolators 6a and 6b which generate a sample.
[0004] Drawing 2 is the simplified schematic showing the example to which the sub-band-coding filter equipment of drawing 1 was expanded. DESHIMETO [LF expresses a low frequency signalling channel, HF expresses a high frequency signalling channel, and / the input signal / eight signalling channels] for record, transmission (9), etc. in this drawing. In the array of drawing 2 , transmission, record, etc. of a signal are performed by one eighth of the sample rates of a original input signal about each of eight signalling channels.
[0005] It is desirable to obtain the best of course possible restoration image also in a sub-band-coding system. The sub-band-coding system by which versatility differs is performing restoration near ******** "perfect reappearance." The British patent application GB-9111782.0 No. in our coincidence connection and GB-9115772.7 No. have proposed the full reappearance filter pair for sub band coding. The filter of the equipment proposed by these applications shows the property that at least full reappearance and a straight line serve as a key about a phase and an integer multiplier. A well-known

"half band" filter is used for these equipments. A half band filter has the following properties. namely, the symmetrical frequency response consisting mainly of 1 / 2 nyquist point and a straight-line phase response -- complementary -- when the pair of HPF and LPF is used together, becoming an all-over-the-districts passage filter and a total even number tap multiplier are zero except for a zero term. Such a filter can be shown in illustration as a thing with typical time response (however, fn expresses a Nyquist rate.) as shown in a typical frequency response as shown in drawing 3 , and drawing 4 .
[0006] As equipment as shown in drawing 1 , the decimation and the interpolation filter with which the decimation and the interpolation filter with which low frequency matched reached opposite 1, and high frequency matched 2 reached opposite 3, and the above-mentioned GB-9111782.0 No. has proposed 4. One side of the low frequency filters 1 and 2 is a half band filter. a tap multiplier [as opposed to / the low frequency filter of another side has many taps from a half band filter, and / the filter of this another side] -- the two above-mentioned low frequency filters -- collapsing (convolution) -- it is set by the solution of 1 set of simultaneous equations obtained from the zero term of the half band filter made. A filter 3 is [as opposed to / High frequency filter / 2] an auxiliary filter, and a filter 4 is a complementary filter to 1 (that is, although 3 and 4 have the multiplier of the respectively same magnitude as 2 and 1, the polarity of the multiplier in every other one is reversed). therefore, a low frequency filter pair -- collapsing -- it is a half band filter, and if low and the high pass section are symmetrical, "perfect reappearance" will be attained certainly. The above-mentioned GB-9115772.7 No. has proposed equipment similar to this. The inside of the 1st and 2nd filters with which it makes one pair of the decimation and the interpolation filters which matched, The 1st filter is a half band filter and the 2nd filter has more taps of at least one pair than the 1st filter. The tap multiplier of the 2nd filter the 1st and 2nd filters -- collapsing -- with the solution of 1 set of simultaneous equations obtained from the zero term of the half band filter made It is set by repetition of trial-and-error including setting up the tap multiplier which the 2nd filter chose so that it may be set by the solution of the simultaneous equations about the group of the tap multiplier in which the remaining tap multiplier of the 2nd filter made [above-mentioned] selection.
[0007]
[Problem(s) to be Solved by the Invention] This invention tends to offer the subband filter equipment which there is little hardware remarkably and ends compared with the conventional thing mentioned above.
[0008]
[Means for Solving the Problem and its Function] This invention subband filter equipment has a decimation stage and a interpolation stage, it connects with the common input from which each stage of a decimation stage has one DESHIMETA, and each stage receives an input signal including a low frequency way (pass) and a high frequency way, and each way of a interpolation stage is connected to a means to compound the signal which has one interpolator and is outputted along both ways. This invention equipment prepares further the low-pass half band filter which has odd taps in the low-frequency way of one stage of decimation and a interpolation stage, prepares an all pass (passage all over the districts) filter in the low-frequency way of the stage of another side of the stage, prepares a complementary high-pass half band filter in the high-frequency way of the stage of another side of decimation and the number of interpolation, and prepares an all pass filter in the high-frequency way of the stage of another side of the stage.
[0009] Therefore, the filter equipment by this invention includes only the filter stage of the moiety of the equipment proposed before from an all pass filter being prepared in one side of the way of two decimation and a interpolation stage, respectively (that is, these ways being mere all pass ways). In what was proposed before, a half band filter is used for each of a high region and the low pass section as the 1st filter. Although full reappearance is attained by determining the multiplier to the tap of the 2nd filter in each part that a fold lump of two filters in each part will become a half band filter, and making symmetrical a high region and the low pass section In this invention, full reappearance is simply attained by preparing only one half band filter in each of low and the high pass section, putting these filters on an opposite stage, and conferring necessary symmetric property. Therefore, if the filter equipment by this

invention is used for a sub-band-coding system, it can compare with above-mentioned conventional equipment, and hardware can be remarkably decreased in an a large number sub-band-coding system as shown especially in drawing 2 .

[0010] Like the after-mentioned, a half band filter needs to have the die length of an odd number tap, in order to attain full reappearance. Moreover, a means to compound the signal outputted along with interpolation **** is a rate equal to the multiplier value of the centre tap of a half band filter, and is good to constitute so that the level of a composite signal may be lowered so that the restored signal may have the same signal level as the HARASHIN number level.

[0011] The filter equipment by this invention can be advantageously used in some fields of video signal processing. When LPF is in the interpolation stage of filter equipment and HPF is in the decimation stage of filter equipment especially, this invention offers the video signal processing system equipped with the following filter equipments for processing the progressive (one by one) scan format video signal supplied to the input of the decimation stage of filter equipment. In the system, the delay element of a half band filter As those filters are constituted as a perpendicular filter, it is the Rhine delay element. DESHIMETA of a low frequency way It is constituted so that pixel (pixel) Rhine of the odd number in the continuous progressive scan frame supplied to this and even pixel Rhine may be chosen by turns. DESHIMETA of a high frequency way is constituted so that even-pixel Rhine and odd-pixel Rhine in the corresponding continuation frame supplied to this may be chosen by turns. Thereby, the signal outputted along the low frequency way of a decimation stage at the time of use turns into a 2:1 jump format video signal which has a field rate equal to the frame rate of an input progressive scan format signal. Since wave filtration of the 2:1 jump format signal especially outputted along the low frequency way of a decimation stage is not carried out, this configuration is advantageous, therefore it does not have the loss (loss) of perpendicular direction resolution, and can reproduce a original progressive scan format signal further that top. On the other hand, the loss will arise in the vertical definition of a 2:1 jump format signal, since a filter is in the low frequency way of a decimation stage supposing it uses similarly the filter equipment proposed in front of the **** for progressive scan-jump conversion. Therefore, the image obtained by the display of the jump signal will become a "bearish" thing.

[0012] When LPF is in the same filter configuration, i.e., a interpolation stage, and HPF is in a decimation stage, this invention also offers the video signal processing system equipped with the following filter equipments for processing the progressive scan format video signal supplied to the input of the decimation stage of filter equipment. The delay element of a half band filter is a frame delay element, as those filters are constituted as a time amount filter, DESHIMETA of a low frequency way is constituted so that the frame in every other one of the above-mentioned progressive scan signal may be chosen, and DESHIMETA of a high frequency way consists of the system so that the frame corresponding to the frame chosen by DESHIMETA of a low frequency way may be eliminated. Thereby, the signal outputted along the low frequency way of a decimation stage at the time of use turns into a progressive scan format video signal with a frame rate equal to one half of the frame rates of an input signal. Therefore, reduction of the frame rate of a progressive scan signal can be attained, without carrying out wave filtration of the signal with which the frame rate outputted by DESHIMETA of a low frequency way decreased, while enabling perfect reappearance of the HARASHIN number. On the other hand, the low frequency decimation filter of these equipments will produce time ****** to the signal with which the frame rate decreased, supposing it uses similarly the filter equipment proposed in front of the ****.

[0013] In a video signal processing system which was mentioned above, it can transmit to a low frequency output, or the high frequency output [DESHIMETO / output] can be encoded in the all pass output [DESHIMETO / output / in order to transmit through a separate channel]. Therefore, this system may also include a means to encode the signal outputted along the high frequency way of a decimation stage in the signal outputted along the low frequency way of a decimation stage in order to transmit, and a means to decode to a component signal in order to supply the transmitted signal to corresponding interpolation ****.

[0014] The filter equipment which materialized this invention can include a mirror image (symmetry) edge escape means to which specular reflection of the sampled value is carried out in the edge (edge) of the sample array supplied to a half band filter, in order to reduce the edge distortion effectiveness. This symmetry edge escape means may also include the random-access-memory (RAM) means for memorizing the sample supplied to a half band filter, and the addressing means for carrying out the address to the above-mentioned RAM means alternatively according to the sample which should be supplied to the above-mentioned filter so that it may state later.
[0015] This invention changes a progressive scan format video signal into a 2:1 jump format signal, and is extended even to the approach of reproducing a original progressive scan format signal later using this 2:1 jump format signal. This approach is performed using the filter equipment described until now.
[0016] This invention is extended also to the approach of changing the 1st progressive scan format video signal into the 2nd progressive scan format video signal with a frame rate equal to one half of the frame rates of this 1st signal again, and reproducing the 1st signal of the above later using this 2nd signal. The approach is performed using the filter equipment described until now.
[0017] furthermore, this invention -- 4x4 video signal -- the 1st and 2nd 4:2:2 video signals -- changing -- after -- this -- it is extended even to the approach of restoring 4x4 video signal from the 1st and 2nd 4:2:2 video signals. The approach is performed using one pair of filter equipments which described each filter equipment until now. This application is described later.
[0018] Generally, when the description is described with reference to the equipment by this invention in this specification, the same description should be given by this invention approach, and please understand that the same is said of the reverse.
[0019]
[Example] Hereafter, a drawing explains this invention concretely. Drawing 5 is the block diagram showing the example of the subband filter equipment by this invention. The subband filter equipment of this drawing has the decimation stage shown by 10 on the whole, and the interpolation stage shown by 11 on the whole. In the interpolation stage 11, the decimation stage 10 contains low frequency way 12b and all pass way 13b including all pass (signal) way 12a and RF way 13a. It has low frequency way 12b of the interpolation stage 11 in it at LPF14. RF way 13a of a decimation stage has HPF15 in it. The all pass way and high frequency way of the decimation stage 10 have DESHIMETA 16a and 16b in it, respectively. Similarly, the low frequency way and the all pass way with 11 interpolation have Interpolators 17a and 17b in it, respectively. ((of course) Although DESHIMETA 16b was separated from the filter 15, interpolator 17a was separated from the filter 14 and it was shown in order to make it intelligible, DESHIMETA16b and interpolator 17a may be prepared as some filters 15 and 14, respectively) Both the ways 12a and 13a of the decimation stage 10 are connected to the common input 18 in order to receive an input signal. Both the ways 12b and 13b of the interpolation stage 11 are connected to the adder 19 adding the signal outputted along both [these] ways. As for this filter equipment, transmission, record, etc. of a signal perform 20 at the rate of the one half of the sample rate of the signal supplied to an input 18.
[0020] In order to give perfect reappearance, LPF14 and HPF15 are half band filters, and HPF15 is the complementary filter of LPF14. That is, although a filter 15 has the multiplier of the same magnitude as a filter 14, the polarity of a multiplier is reversed alternately. In addition, filters 14 and 15 have odd taps.

[0021] Drawing 6 is the block diagram showing other examples of the subband filter equipment by this invention. The example of drawing 6 resembles it of drawing 5 generally, and has given the same sign to the corresponding part. However, in this example, the decimation stage 10 has low frequency way 22a and all pass way 23a, and the interpolation stage 11 has all pass way 22b and RF way 23b. In this example, LPF14 is in low frequency way 22a of the decimation stage 10, and HPF15 is in RF way 23b of the interpolation stage 11.
[0022] The actuation which attains full reappearance of drawing 5 and the filter equipment of 6 is explained with reference to drawing 7 from this. Drawing 7 shows the signal which exists in the various phases in the example of drawing 5 to a specific input and the set of a half band filter. Although what

kind of order's being sufficient as the multiplier of a half band filter, speaking generally, let LFP14 be the half band filter with the following multipliers of 1/4 order in this example.
- 1, 0, 9, 16, 9, 0, -1 Sum = it depends 32 and the multiplier of complementary HPF is as follows.
1, 0, and - 9, 16, -9, and 0 and 1 [0023] Now, the input signal which consists of the stream of the input sample shown in the (a) train of drawing 7 assumes that the input 18 of the equipment of drawing 5 was supplied. However, the delay element of a half band filter is 1 sample delay element. When the low frequency section of equipment is considered first, the signal outputted from DESHIMETA 16of all pass way 12a a comes to be shown in the (b) train of drawing 7 . DESHIMETA 16a only lowered the sample rate at the rate of 2, in this example, chose the sample in every other one, and has eliminated other samples. Since filters 14 and 15 have odd number tap length, DESHIMETA 16a and 16b takes opposition, and DESHIMETA 16a chooses an even number sample from an input stream. An operation of interpolator 17a is inserting 0 value sample in the location of the sample eliminated by DESHIMETA 16a to which the sample stream which received corresponds, and restoring a original input sample rate. Wave filtration of the output of interpolator 17a is supplied and carried out to LPF14 from it. In the multiplier set mentioned above, the output to way 12b of LPF14 comes to be shown in the (c) train of drawing 7 .
[0024] Next, considering the radio-frequency head of equipment, wave filtration of the input stream shown in the (a) train of drawing 7 is supplied and carried out to HPF15 in way 13a. In the multiplier set mentioned above, the output of HPF15 becomes like the (d) train of drawing 7 . DESHIMETA 16b chooses an odd number sample from the sample stream which received, and as shown in the (e) train of drawing 7 , it produces an output from it at the rate of the one half of a original input sample rate. Similarly, interpolator 17b in way 13b inserts 0 value sample in the location corresponding to the location of the sample eliminated by DESHIMETA 16b to which the sample stream which received corresponds, and performs the operation which restores a original input sample rate. Therefore, the output of interpolator 17b to way 13b becomes like the (f) train of drawing 7 .
[0025] The signal outputted along both the ways 12b and 13b of a interpolation stage is supplied and added to an adder 19, and produces an addition output as shown in the (g) train of drawing 7 . (a) If a train is compared with the (g) train, it is clear that set aside the scaling factor (scale factor) 16 and perfect reappearance is attained. The scaling factor of 16 corresponds to the multiplier value over the centre tap of the half band filters 14 and 15. Therefore, the output of an adder 19 may be supplied to a scaler (counter) in order to lower the level at a rate equal to a centre tap multiplier value.
[0026] Although the above-mentioned example explained actuation of the equipment of drawing 5 , probably, by performing same analysis also with the equipment of drawing 6 shows that the same result is obtained.
[0027] In order to attain full reappearance, it is clear from consideration of the easy example of drawing 7 that it is necessary a half band filter's to have odd taps. Moreover, in the case of a n-bit input sample, it is admitted that the half band filter 14 of a decimation stage or the output of 15 should supply a bit sample for full reappearance (n+1). The output of all pass way 12a of a decimation stage or 23a is still n bits. This differs from the conventional wave filtration actuation whose output must generally be the thing of resolution much higher than n bits.
[0028] It turned out that it is suitable for a progressive scan format and especially the conversion between 2:1 jump format video signals so that the filter equipment of drawing 5 might be described with reference to drawing 8 from this. By choosing odd-pixel Rhine of this frame, making the odd number field, choosing even-pixel Rhine of this frame, and making the even number field from each frame of this progressive scan format signal, the progressive scan format signal corresponding to per second x frames can draw the 1 field of a 2:1 jump format signal, and can change it into the 2:1 jump format signal corresponding to the per second x field. Therefore, this processing is easy perpendicular subsampling which shifts a sample for every field, as shown in drawing 8 . The pixel array of the progressive scan format signal within a perpendicular-time amount (V/T) side is shown in the left-hand side of drawing 8 . That is, the column (column) with which this array continues expresses the pixel of a certain column of the video image in the frame which continues in time. The pixel array corresponding

to the right-hand side of drawing 8 in the 2:1 jump format signal within a perpendicular-time amount side is shown. Therefore, similarly the continuation column of this array expresses the pixel of a certain column of the video image in the field which continues in time. As shown in drawing, in order to make a jump signal, in this subsampling processing, the pixel in every other one in a column is eliminated in each field. Alternation of the location of the pixel eliminated is carried out for every field.
[0029] The filter equipment of the type shown in drawing 5 can perform perpendicular subsampling shown in drawing 8 . In this case, a filter is constituted as a perpendicular filter and, as for the delay element of a filter, it is good that it is [of the progressive scan format signal to which the Rhine delay element, i.e., an input pixel sample is supplied by the input 18] the component to delay during the one-line (scanning line) period. DESHIMETA 16of all pass way 12a a is constituted so that pixel Rhine in every other one in 1 input frame may be chosen, and one-line delay is applied to the input frame in every other one so that odd-pixel Rhine and even-pixel Rhine of an input frame where DESHIMETA 16a continues may be chosen by turns. Although DESHIMETA 16b similarly chooses pixel Rhine in every other one in each input frame, as for the actuation, only in actuation and the one-line period of DESHIMETA 16a, the phase has shifted. In this way, DESHIMETA 16a performs subsampling actuation shown in drawing 8 to the input signal on all pass way 12a. Wave filtration of the input signal on high frequency way 13a is carried out, and DESHIMETA 16b chooses the pixel corresponding to the pixel which was shown as a pixel eliminated in drawing 8 and by which wave filtration was carried out.
[0030] Therefore, in an above-mentioned configuration, the output of DESHIMETA 16a in all pass way 12a of a decimation stage is the usual 2:1 jump format signal with the field rate corresponding to the frame rate of an input progressive scan signal, as shown in drawing 8 . DESHIMETO [it / wave filtration of the input frame is perpendicularly carried out by HPF15, and / DESHIMETA 16b] like **** on RF way 13a of a decimation stage. Therefore, the high pass output [DESHIMETO / output] expresses the TOWITTA (twitter) component between Rhine corresponding to the "missing" pixel in the jump format output of DESHIMETA 16a. Moreover, since this jump output only chooses a sample from an input signal, notice the jump output of an all pass way about being expressed by the bit of this input signal and the same number.
[0031] In the number of interpolation, each interpolators 17a and 17b carry out actuation which restores a original sample rate by introducing 0 value sample into the location corresponding to the location of the sample eliminated by correspondence DESHIMETA16a or 16b in an input sample stream. Wave filtration of the output of interpolator 17a is perpendicularly carried out by LPF14 from it, and the sample stream generated on way 12b and 13b is added by the adder 19. The level of the signal outputted by the adder 19 is lowered at a rate equal to the multiplier of the centre tap of filters 14 and 15 by the reason explained above. The lowered output expresses that by which the original input progressive scan format signal was reproduced completely.
[0032] A progressive scan format video signal is convertible for a standard 2:1 jump format signal with an above-mentioned configuration, in order to transmit to remote TV receiving set. It can encode in a jump signal for transmission, or the high pass output [DESHIMETO / output] can also be transmitted through an addition channel. The usual TV receiving set will receive a standard 2:1 jump signal, and will drive the jump display, since it disregards high pass data. However, improvement in image quality can be aimed at by including the interpolation stage of the above-mentioned filter equipment in a high-class receiving set, restoring a original progressive scan signal, and driving a progressive scan display. Furthermore, since there is no wave filtration process in decimation way 12a, note that there is no loss of the vertical definition in 2:1 jump signals used for the usual receiving set.
[0033] Since the filter equipment of the type shown in drawing 5 controls a "flicker", it is applicable to frame rate conversion of a progressive scan video signal again. That is, when a flicker is moved by the display image by the frame rate as which a continuous frame is displayed, it can be used advantageously. For example, the conventional progressive scan TV display ** each received frame of a progressive scan signal the first half of the 2nd inning, in the case of 50Hz signal, it can control a flicker by displaying a frame, namely, **(ing) each frame of 50Hz signal the first half of the 2nd inning by 100Hz. Although a flicker decreases carrying out like this, since the double image effectiveness arises

and a motion fades by **(ing) each frame the first half of the 2nd inning, the quality of movement depiction deteriorates. If the filter equipment of the type shown in drawing 5 is used, it is twice the standard rate, for example, TV signal can be acquired by 100Hz instead of 50Hz. In order to use it like usual for the conventional TV receiving set for transmission, 50Hz signal can be taken out. However, according to the high-class receiving set including the interpolation stage of filter equipment, in order to display, the original 100Hz signal is reproducible. Thereby, a flicker is controlled, without reducing the quality of movement depiction in any way.

[0034] As shown in drawing 9 , it is essentially time subsampling to lower a frame rate. The pixel array of the 100Hz progressive scan video signal in a perpendicular-time amount (V/T) side is shown in the left-hand side of drawing 9 . The pixel array corresponding to the right-hand side of drawing 9 in 50Hz progressive scan signal is shown. This shows that the pixel of the frame in every other one of 100Hz signal is eliminated by subsampling processing. The decimation stage of the filter equipment of the type shown in drawing 5 can attain this time subsampling processing. In this case, filters 14 and 15 are constituted as a time amount filter, and the delay element of these filters is a frame delay element (namely, component which delays only the one-frame period of the progressive scan format signal to which an input sample is supplied by the input 18). DESHIMETA 16of all pass way 12a a is constituted so that the pixel of the input frame in every other [which is supplied to this] one may be chosen. DESHIMETA 16b operates with the phase from which only DESHIMETA 16a and an one-frame period shifted. When it carries out like this, in high frequency way 13a, wave filtration of the input frame will be carried out in time by HPF15, and DESHIMETA 16b will choose the pixel corresponding to the pixel which was shown as a pixel eliminated in drawing 9 and by which wave filtration was carried out.

[0035] Therefore, probably, this configuration shows that the output of DESHIMETA 16a becomes the progressive scan signal of the rate of the one half of the frame rate of the input signal shown in drawing 9 . For transmission, it can include in the output of DESHIMETA 16a, and can encode, or the high pass DESHIMETO output of way 13a can be transmitted through an auxiliary channel. 50Hz signal could be received and used as usual, since the conventional TV receiving set disregards an auxiliary data in both cases. However, by the high-class receiving set, the interpolation stage 11 of the filter equipment of drawing 5 will be included. In this case, each interpolators 17a and 17b carry out actuation which restores the sample rate of a original input progressive scan signal by introducing 0 value sample into the location in an input sample stream corresponding to the location of the sample eliminated by corresponding DESHIMETA16a or 16b. the output of interpolator 17a -- and wave filtration is carried out in time by LPF14, and the sample stream generated on the ** (signal) ways 12b and 13b is added by the adder 19. From it, in order to return the level of the output signal of an adder 19 to the HARASHIN number level, it is lowered at a rate equal to the multiplier of the centre tap of filters 14 and 15. This lowered output expresses what was restored completely [a original input progressive scan format signal].

[0036] Therefore, according to the configuration mentioned above, TV signal is created by the twice of the usual scan rate, since it uses for the conventional receiving set, a standard frame rate signal can be drawn and it can transmit, and by the high-class receiving set, a original progressive scan signal can be restored and display image quality can be improved. Since there is no wave filtration process in decimation way 12a, there is no **** [which lowers the visibility of the image in a receiving set] time small-fire injury in the standard frame rate signal which DESHIMETA 16a outputs conventionally which uses only a standard frame rate signal.

[0037] Although the alias (duplication distortion) of a certain extent arises from **** in the signal output which meets this way by subsampling processing since there is no filter in way 12a of the filter equipment of drawing 5 , this has an advantageous signal by device with a certain type of ordinary alias which expresses a scan correctly and which was mentioned above.

[0038] The filter equipment of the type shown in drawing 6 is applicable to conversion between **** described with reference to drawing 10 from this, 4x4, and 4:2:2 video signals. 4x4 signals are all bandwidth signals that have the linearity key channel K in Y, B-Y, and a R-Y channel list. The data rate is 2xCCIR601. By the way, it will be necessary to record 4x4 signals on two digital video recorders

(DVTR) as two signals [4:2:2]. This can be attained by the easy approach using two data dividers 20a and 20b, as shown in drawing 10 . Each data divider includes the decimation stage 10 of filter equipment as shown in drawing 6 . The B-Y channel of 4x4 signals is supplied to the input 18 of the decimation stage 10 which forms data divider 20a. Similarly, the R-Y channel of 4x4 signals is supplied to the input 18 of the decimation stage 10 which forms data divider 20b. Data divider 20a is two signals CB about a B-Y signal. And it divides into CB '. These two signals are the outputs of DESHIMETA16a in data divider 20a, and 16b each. That is, it is CB as shown in drawing. It is the signal outputted along with (low frequency LF) decimation way 22a, and CB ' is a signal outputted along with all (pass AP) decimation way 23a. Similarly, R-Y signals are two signals CR which are the outputs of DESHIMETA16a [in / by data divider 20b / this divider], and 16b each. And it is divided into CR '. Namely, CR It is the signal outputted along with (low frequency LF) decimation way 22a, and CR ' is a signal outputted along with all (pass AP) decimation way 23a.

[0039] Chrominance signal CB And CR The 1st DVTR (DVTR1) is supplied together with Y component of 4x4 signals, and chrominance-signal CB ' and CR ' are supplied to the 2nd DVTR (DVTR2) together with K component (sent as Y" of signals.). If wave filtration of the signal of a data divider LF on the street is carried out, the 4:2:2 sources (source of a signal) without an alias will be given to one channel (to DVTR1), and the mere division component of original data will be given to the channel of another side (to DVTR2). Namely, Y and CB which are supplied to DVTR1, and CR Signals are the color components CB and CR which have the contents of a low alias frequency since the response of the half band filter 14 in 1/2 frequency of nyquist is -6dB. It has. Therefore, Y, CB, and CR A high quality image is obtained from a signal. Although the color component of CB ' and CR ' signal is a component by which the subsample was only carried out, since CB ' and CR ' signal are mere additional signals which are not directly used independently, Y " of Y " of the quality is not so important here. This signal is used to reproduce 4xoriginal 4 signals from two signals [4:2:2]. In this case, perfect restoration of a B-Y component is simply attained by supplying Signal CB and CB' to the interpolators 17a and 17b of the interpolation stage 11 as shown in drawing 6 . When similarly perfect restoration of a R-Y component also supplies Signal CR and CR ' to the interpolators 17a and 17b of the interpolation stage 11 as shown in drawing 6 , it is reached simply.

[0040] There is an edge effect of a certain extent in any wave filtration actuation. When an input sample stream is supplied to two or more taps of a filter, since the output sample by which wave filtration was carried out corresponds to the input sample supplied to the centre tap, the edge distortion effectiveness generates it. Therefore, when an input sample array is finite, with the edge (edge) of this array, the samples for generating the wave filtration output sample corresponding to an input sample run short. For this reason, the edge distortion effectiveness occurs and it depends for extent of that distortion on the order (the number of taps) of the filter concerned.

[0041] Although there were some methods of reducing the edge distortion effectiveness, in the case of the phase subband filter, at least symmetrical and a straight line were determined that an edge effect will be cancelable by [like the half band filter used for the example of this invention] using mirror image (symmetry) edge escape technique. According to this technique, the sample in the edge of the sample array supplied to a half band filter can be symmetrically extended to the surroundings of an edge like a mirror image, and can give a required input sample, and the wave filtration (carried out) output sample corresponding to the input sample near the edge of an array can be generated. For example, in the case of the input array in which a value has the sample location which attains to 0-max (max), a mirror image escape is performed as follows.

case of value <0 value = - value value -- case of >max value = (max* 2) - value [0042] A paraphrase addresses data like a mirror image. if the sample block of size N is given, a polar sign will reverse each sample address smaller than zero -- having -- a value X -- having (N-1) -- a polar sign reverses each large sample address -- having -- a value X -- having (N-1) -- each (2*-(N-1) X) large sample address is changed. For example, when the maximum address is 255 in N= 256, the address value of 256 is changed into =(510-256) 254.

[0043] Drawing 11 is the explanatory view showing mirror image escape technique. The central block

30 tends to express the group of the sample of the given sample array, and tends to generate the wave filtration output sample corresponding to this. In this example, the group of the above-mentioned sample is assumed to be n-pixel Rhine to the right-hand side image edge which is in a pixel location (n-1) from the left-hand side image edge 32 in the pixel location 0. Specular reflection (36) of the pixel locations 1, 2, and 3 from the left-hand side image edge 32 to the right and .... is carried out on the left of the left-hand side image edge 32. Specular reflection (38) of the pixel location n-1 from the right-hand side image edge 34 to the left, n-2, and .... is carried out on the right of the right-hand side image edge 34. It depends on the number of taps of the filter related to this reflection for the number of the pixel locations by which specular reflection (symmetry escape) is carried out. That is, when the filter concerned has the tap of (2m+1) in all, specular reflection of the m pixels is carried out.
[0044] Drawing 12 is the block diagram showing the equipment which enforces mirror image escape technique of drawing 11 . The equipment of this drawing performs a mirror image escape within a digital filter using separate components. For example, in the perpendicular wave filtration actuation performed when using the filter equipment of drawing 5 for above-mentioned progressive scan and jump conversion, the input sample corresponding to the pixel of one frame is memorized by random access memory (RAM) 40. The RAM address controller 42 specifies alternatively read-out to RAM, and the write-in address in order to choose the pixel value which should be supplied to the digital filter integrated circuit (IC) 44. In this case, since it is going to carry out wave filtration of the column (column) of a pixel, a mirror image escape must be performed to the surroundings of an up-and-down image edge. In this example, since the delay element of a filter is the Rhine delay element, pixel Rhine in the memorized frame should carry out a mirror image escape around the edge of the upper and lower sides of this frame. Therefore, the RAM address controller 42 controls supply in the filter of pixel Rhine, and pixel Rhine by which a mirror image escape was carried out is supplied at a frame blanking period. The equipment 46 containing RAM40, the RAM address controller 42, and a digital filter IC 44 can be used for constituting one of the filters 14 and 15 in an above-mentioned example. In that case, the RAM address controller 42 controls the writing of the sample to RAM40, and supply of the sample to a digital filter IC 44. When performing wave filtration processing along with a time-axis, along with a time-axis, must also perform an edge escape, namely, a delay element must be the field or a frame delay element.
[0045]
[Effect of the Invention] According to this invention, the subband filter equipment used for a sub-band-coding system can be constituted so that there may be little hardware remarkably and may end compared with the conventional thing, as explained above.

[Translation done.]